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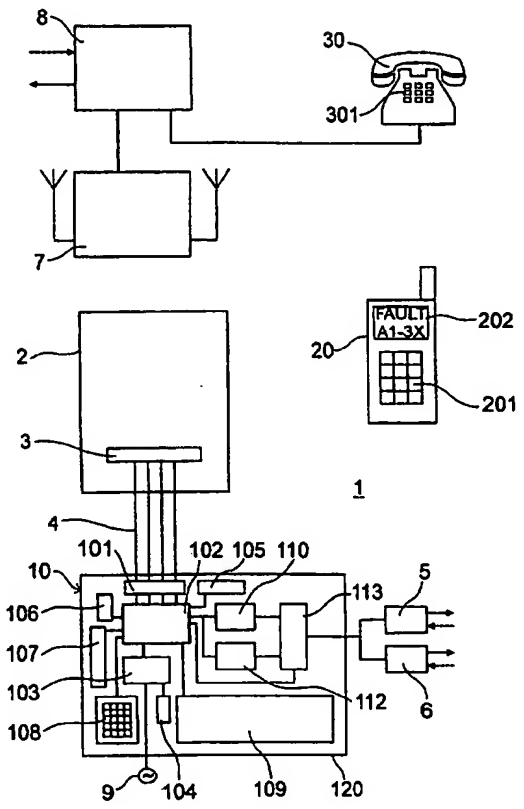
(54) Abstract Title
Telemetry systems

(57) A telemetry system 1 monitors parameters of a plant 2 having a monitor centre 3 which outputs monitor signals on monitor lines 4 to a GSM outstation 10. In the event of a reportable condition arising, or at a predetermined time, a controller 102 sends a control signal to a text generator 112, which generates a respective text message. This is transmitted as an SMS text message via a transmitter-receiver unit 113 and through a GSM modem 5, to be received on a GSM telephone 20, where the SMS text message appears on the telephone display 202. In addition to waiting to receive messages generated by the GSM outstation 10, a user can dial into the GSM outstation 10 at any time, to obtain a status report of any desired parameter or send an instruction to cause desired operation of an item of plant equipment. The controller 102 is preferably a simple controller, without the full functionality of a PC.

Thus, a maintenance engineer in the field can receive reports from plants such as 2 in a simple and economical manner when at a remote location, without the need for a PC or more substantial computer, either where the engineer is located or at the GSM outstation 10.



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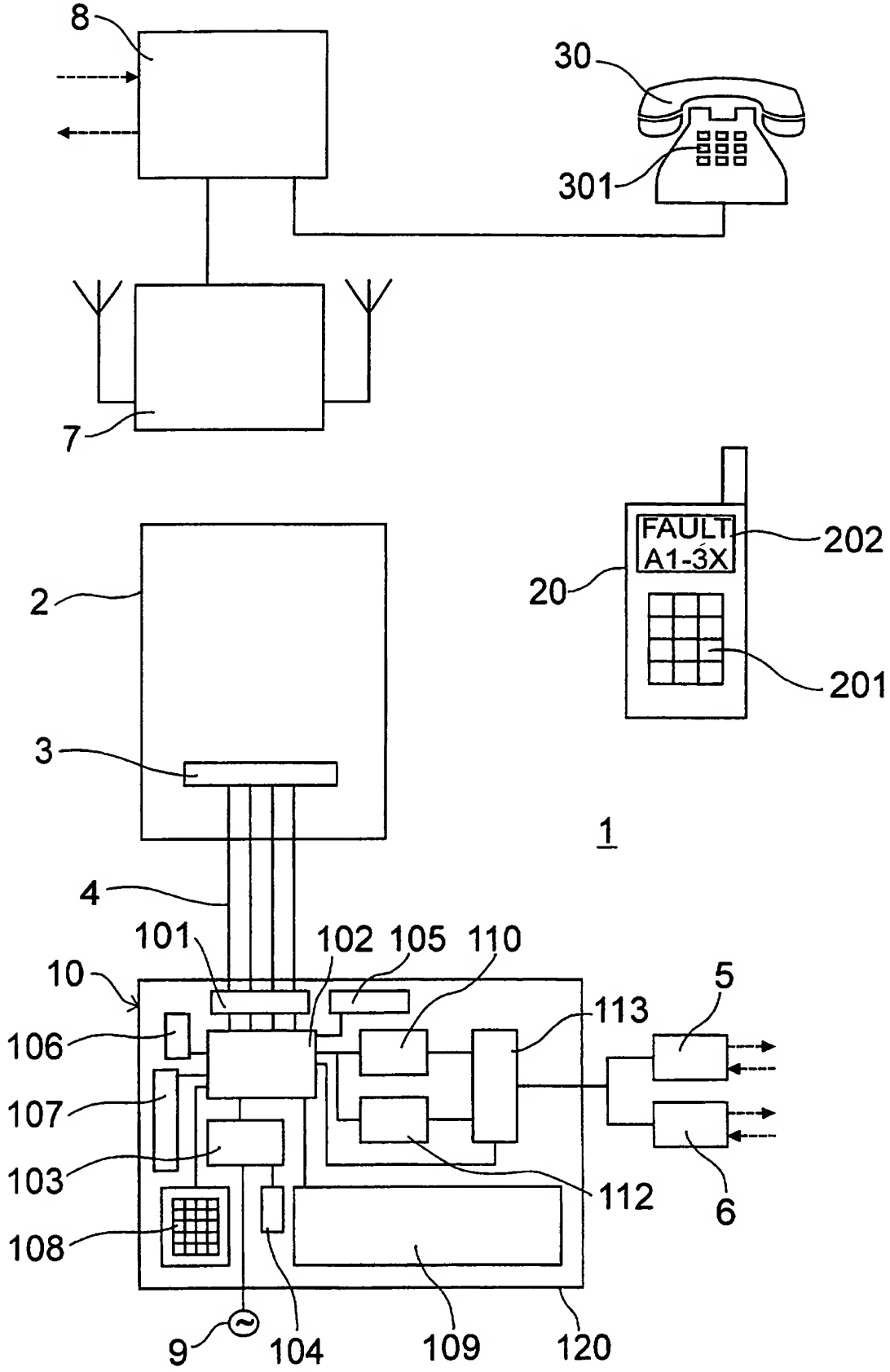
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TELEMETRY SYSTEMS

This invention relates to telemetry systems.

Telemetry systems have been in wide use for many years - wherever it is desired to monitor a parameter at a remote location. Many modern processes run to a great extent automatically, requiring little physical supervision by maintenance engineers. However, it is of course important for such engineers to be alerted to fault conditions that may arise. Therefore, it is common for a computing device to be provided in many modern plants, to monitor parameters of interest, detect fault conditions, and send alarm signals to a remote control centre, where alarms can be noted and remedial action taken.

For convenience, in the context of this specification, the term "plant" is used in a wide sense, to include any thing or process having a parameter which is to be monitored: and the term "monitor" is used in a wide sense to embrace general monitoring of any desired parameter, alarm signals to denote alarm conditions, and any other signal of interest.

A very distinct trend in conventional telemetry systems is to provide a computer at both ends of a telemetry link. A first computer monitors parameters at a plant and initiates report signals over the telemetry link. A second computer at a remote control centre at the other end of the link receives monitor signals (including alarm signals), processes them, and provides indications to personnel at the control centre. Another distinct trend over recent years is to provide such computing devices by way of

"personal computers" (PC's) which, being of ever increasing power, can handle very complex control operations.

All of this is very well in large industrial plants, where the cost of PC's for telemetry operations may be of little significance, and where often significant numbers of maintenance personnel are available to respond to local requirements. However, we have identified a problem in that, for more simple and/or lower value plants, the cost of providing PC's at both ends of a telemetry link can be significant. In many industrial plant environments, a typical PC would be totally unsuitable for use, due to its relative sensitivity to mechanical impacts, vibration, corrosive environments, etc. Building full PC's in what are known as "ruggedised" cases to withstand hostile industrial environments can be an expensive business.

We have also identified the problem that, even in a large industrial plant, a number of different firms can be responsible for the operation of different parts of the plant. Each firm ideally requires its own telemetry system to notify its own field maintenance engineers of any problems. Such field maintenance engineers often spend a lot of their time on the road, away from remote control centres with PC's. Portable PC's (such as "laptop" PC's) are widely used at the present time. However, they still tend to be of significant size, with significant power requirements, and an inconveniently short battery life.

It is known for plant monitoring systems to dial out to a predetermined telephone number in the event of an alarm. However, such systems generally require a PC or higher power computer with high-level operating system at the plant site and dial out only in the event of a fault.

Preferred embodiments of the present inventions aim to provide telemetry systems which may be improved, in addressing the above-mentioned problems.

According to one aspect of the present invention, there is provided a telemetry system comprising:

a. input means arranged to receive a monitor signal from a plant to be monitored;

b. a controller arranged to receive said monitor signal from the input means and to generate a control signal in response to said monitor signal;

c. a report generating means arranged to receive said control signal and to generate in response thereto a report signal in either voice or text form; and

d. transmission means for transmitting said report signal as either a PSTN or mobile telephone signal in the case of a voice report signal, and as a mobile telephone signal in the case of a text report signal.

Such a telemetry system may further comprise receiver means for receiving an interrogation signal as either a PSTN or mobile telephone signal: wherein said controller is adapted to generate a response signal in response to said interrogation signal, which response signal depends upon a parameter of said input signal; and said report generating means is arranged to receive said response signal and to generate in response thereto a report signal as aforesaid, which report signal is then transmitted by said transmission means as aforesaid.

Preferably, said interrogation signal is a text signal, a tone signal, or a voice signal.

Preferably, said controller is arranged to be programmed by an external device, and is provided with an input/output port for communication with said external device.

Preferably, said controller is arranged to run normally without connection to said external device.

A telemetry system as above may be provided in combination with a mobile telephone arranged to receive voice and/or text messages transmitted by said transmission means.

Preferably, the receiver means is arranged to receive said interrogation signal as input at and transmitted by said mobile telephone.

A telemetry system as above may be provided in combination with a PSTN telephone arranged to receive voice messages transmitted by said transmission means.

Preferably, the receiver means is arranged to receive said interrogation signal as a voice or tone signal input at and transmitted by said PSTN telephone.

Preferably, only one or more mobile telephone and/or one or more PSTN telephone is provided to receive said report signal, without the provision of a PC or other computing device.

Preferably, only one or more mobile telephone and/or one or more PSTN telephone is provided to transmit said interrogation signal, without the provision of a PC or other computing device.

Preferably, said input means is arranged to receive a plurality of said monitor signals from a plant to be monitored; said controller is arranged to receive said monitor signals from said input means and to generate a plurality of control signals in response to said monitor signals; said report generating means is arranged to receive said control signals and to generate in response thereto a plurality of report signals in either voice or text form; and said transmission means is arranged to transmit said report signals as either PSTN or mobile telephone signals in the case of a voice report signal, and as mobile telephone signals in the case of a text report signal.

Preferably, said monitor signal or one of said monitor signals represents a fault condition, and a corresponding said report signal represents the fault occurring or the fault being cleared.

Preferably, at least some of said monitor signals represent current parameters of the plant.

Preferably, the controller is arranged to produce respective said control signals corresponding to said monitor signals which represent current parameters of the plant, and the transmission means is arranged to transmit respective report signals corresponding to those control signals, at predetermined times.

Preferably, said input means, controller and report generating means, and at least part of said transmission means, are contained within a common housing.

Preferably, said common housing is ruggedised to protect the components inside the housing from mechanical impact and/or corrosive environments.

For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawing, the single figure of which illustrates one example of a telemetry system embodying the present invention.

The illustrated telemetry system 1 comprises as essential components a GSM (Global System for Mobile Communications) outstation 10 and a GSM telephone 20 with SMS (Short Messaging Service) text messaging capability. The GSM outstation 10 sends and receives voice, text and data messages via a GSM modem 5. This communicates with a GSM network in a conventional manner, typically via one or more GSM relay station 7, which in turn provides a communication link for the GSM telephone 20.

It is to be understood that, although reference is made in this specification conveniently to the currently popular "GSM" standard of mobile telecommunications, any other mobile telecommunications standard or system may be employed, which supports the transmission of voice, text and preferably data.

The GSM outstation 10 also provides a standard telephone link via a PSTN (Public Switched Telephone Network) modem 6, for communication with a PSTN telephone 30 with numeric or alphanumeric touch-tone (DTMF: Dual-Tone Multi-Frequency) keypad 31, connected via a local PSTN node 8, which may also receive telephone signals from the GSM network.

The telemetry system 1 monitors parameters of a plant 2 having a monitor centre 3 which outputs monitor signals on monitor lines 4.

The GSM outstation 10 has an input port 101 to receive the monitor signals on the monitor lines 4. A controller 102 receives the monitor signals from the input port 101 and, in dependence upon the value of the monitor signals, generates respective control signals which are fed to either or both of a voice generator 110 and a text generator 112. The voice generator 110 generates a report signal in voice form, whereas the text generator 112 generates a report signal in text form - for example, SMS text messaging. Both report signals go to a transmitter-receiver unit 113, which drives the GSM modem 5 and/or PSTN modem 6.

The controller 102 is provided with a memory 105 and an I/O port 106 for programming. It is also connected to a printer interface 107. An optional local control pad 108 is provided, as is an optional local display 109. A power supply 103 is adapted to receive power from either mains 9 or a battery backup 104, and provide power to the controller 102 and all other powered components of the GSM outstation 10.

All of the components of the GSM outstation 10 are contained within a ruggedised housing 120, which affords protection to the components from mechanical shock, vibration and corrosive environments. Where the local control pad 108 is provided, it will typically be a simple numeric or alphanumeric keypad with a sealed outer membrane for protection, in contrast to a full QWERTY-type keyboard as may be used on a typical PC or other computing device. All active components of the GSM outstation, and in particular the memory 105, are solid state, such that they are less susceptible to impact, vibrations, etc than would be relatively delicate items such as hard disk drives, upon which conventional PC's depend.

For simplicity of operation, the controller 102 does not have an "operating system" as such, but runs raw assembly code, which is stored in a non-volatile memory. Thus, the GSM outstation is less susceptible to power outages and interruptions, than would be a conventional PC which requires re-booting after power interruption. In order to program the controller 102, connection is made via the I/O port 106 to, for example, a laptop PC, having appropriate software for programming the response criteria of the controller 102. It is to be noted that, once programmed, the GSM outstation 10 requires no connection to any other computing device such as a PC, in order to operate. The PC is provided only for programming purposes.

In use, the controller 102 continually monitors the monitor signals on the lines 4, and compares them with predetermined values. When a monitor signal falls outside a predetermined value or range of values, the controller 102 sends a respective control signal to the voice generator 110 or text generator 112, which generates a respective, predetermined message.

In a typical case, an SMS text message is transmitted via the transmitter-receiver unit 113 and through the GSM modem 5, to be received on the GSM telephone 20. The SMS text message appears on the display 202.

This is where a particular advantage of the illustrated telemetry system 1 becomes apparent. Almost all field maintenance engineers will these days carry a GSM telephone, most recent models of which have an SMS text messaging facility, and as compared to a typical portable PC of any kind, are relatively small, light, and operate for extended periods of battery life. Upon a fault occurring at a remote plant, the field maintenance engineer may be notified immediately of the fault, by way of the GSM telephone 20. The fault message will include a unique code, which denotes the particular plant and the particular fault at that plant.

In addition to transmitting fault messages, the GSM outstation 10 may transmit routine reports - typically, at predetermined intervals of time. Therefore, for example, the field maintenance engineer may receive at (or about) a predetermined time each day (or at any other required time interval) a report of relevant parameters at any plant of interest. In this way, the engineer can have a daily check that all appears to be well in a plant of interest. This can, of course, be repeated for as many plants as required.

In addition to waiting to receive messages generated by the GSM outstation 10, the maintenance engineer in the field can dial into the GSM outstation 10 at any time, to obtain a status report of any desired parameter.

For example, the engineer can dial into the GSM outstation 10 rapidly, by way of a stored number in the GSM telephone 20, and upon establishing communication with the outstation 10, can transmit a predetermined code (which can also be a stored number in the telephone 20), by way of the alphanumeric keypad 201. The predetermined code represents an interrogation signal, and causes the controller 102 to generate one or more control signal which reflects the value of a parameter indicated by one or more of the monitor signals on the monitor lines 4. The text generator 112 (in this example) generates an appropriate report text message, which is transmitted over the GSM network as before, and appears as a message on the display 202 of the GSM telephone 20.

Thus, upon demand, the field maintenance engineer can interrogate any plant of interest, and be provided with one or more text message on the GSM telephone display 202, to indicate the status of one or more parameters of the plant. For example, in a chemical process plant, the field maintenance engineer can determine the level of any particular stock material for the process. In another example, in a pumping station, the field maintenance engineer can establish the status of operation of all of the pumps, levels of liquids in storage containers, etc.

It is of particular significance that, in the illustrated telemetry system 1, both the GSM outstation 10 and the GSM telephone 20 can be provided in a very cost-effective manner. In particular, apart from initial programming and subsequently desired re-programming of the GSM outstation 10, there is no need for a sophisticated PC, either at the site of the plant 2, or at the location of the field maintenance engineer. The controller 10 may be constructed with a very simple processor which, as

indicated above, can operate on raw assembly code with no higher level operating system. All of the individual components of the GSM outstation 10 are readily available as modern solid state products, mass-produced at a relatively low price. Equally, at the other end of the telemetry link, the GSM telephone 20 may be provided relatively cheaply, and will almost inevitably be an existing part of the field maintenance engineer's equipment. There is no need for additional computing power for the field maintenance engineer. The existing equipment is perfectly sufficient to provide the required telemetry functions. It is to be noted also that a GSM telephone will be relatively small and light as compared to even a small portable PC, especially since a GSM telephone will typically have an integral keypad which is a small numeric or alphanumeric keypad, rather than a full QWERTY-type keyboard as in a computer or portable computer.

In the above described example, an SMS text message is sent to the GSM telephone, to report on parameters at the plant 2. As an alternative to this, a voice message may be generated by the voice generator 110, and sent to the GSM telephone 20. Voice chipsets are readily available, and may be programmed to provide, in response to the controller 102, a range of different voice messages to report upon various different parameters. Thus, the telemetry system can also be used with GSM telephones that do not have a text messaging facility. As outlined above, the GSM outstation 10 may be interrogated for plant parameters by way of predetermined codes entered by the alphanumeric keypad 201 on the GSM telephone 20 - either as touch tones or SMS text messages.

Voice messages can be equally well received on the standard PSTN telephone 30, received directly over the PSTN network from GSM

outstation 10, or via GSM transmission from outstation 10 to relay station 7 and thence to the PSTN network. Where the telephone 30 is provided with a touch-tone keypad 301, then the GSM outstation 10 can again be interrogated via the telephone 30, as to current parameters of the plant 2.

As an alternative to interrogation by means of tones (e.g. DTMF tones) from touch-tone telephones, the GSM outstation 10 may be provided with a voice recognition system, such that interrogation may be by way of voice commands from telephone 20 or 30. Such a voice recognition system may be very basic - for example, responding simply to the two words "YES" and "NO" in response to predetermined menu questions, and/or simple number recognition.

In all cases where the GSM outstation 10 is interrogated by telephone 20 or 30, the controller 102 may send interrogation signals to the monitor centre 3, in order to initiate transmission of monitor signals over monitor lines 4, to indicate further desired parameters of the plant 2. To this end, one or more of the monitor lines 4 may also be used as a line for transmitting signals from the controller 102 to monitor centre 3, with the input port 101 acting suitably also for the output of signals from the controller 102.

The controller 102 may control output switching signals in dependence upon signals received from telephone 20 or 30. For example, in the event that a field maintenance engineer receives a report of a fault (or any other parameter) on telephone 20 or 30, he/she may send an appropriate control signal to the outstation 10, in the same manner as an interrogation signal, to cause the controller 102 to switch an output signal - for example,

via I/O port 106 or an additional port - to cause desired operation of an item of plant equipment. For example, if the engineer receives a report that a pump fails in a pumping station, the engineer may send a control signal via telephone 20 or 30 to outstation 10, to cause a standby pump to be switched on. The outstation 10 may have one or more on-board relay, to control such output switching.

In addition to the above-described examples of text and voice messaging, the controller 102 may also output a data stream to the transmitter-receiver unit 113, which then transmits the data stream via the GSM modem 5 or PSTN modem 6, to be received at a remote location.

The memory 105 in the GSM outstation 10 may store a number of different telephone numbers to be called, in the event of report signals to be transmitted. Different telephone numbers can be selected, in dependence upon the nature of a particular report signal. The GSM outstation 10 may be arranged to dial successively through predetermined numbers, until a satisfactory response is obtained. In the event of a failure of the mains power 9, the controller 102 may dial out with a power-failure report signal, whilst continuing to operate for some hours on the battery back up 104.

The memory 105 may also store a date- and time-stamped internal event log of, for example, one hundred or more status changes of monitor signals. To this end, the outstation 10 includes its own internal real time clock. It may also keep an event log of calls made and answered. An external printer may be connected to printer interface 107, to enable the event log to be printed, as well as configuration details of the GSM outstation 10. Portable, battery-powered thermal printers are readily

available for such a purpose, and if desired, may be built into the GSM outstation 10 at relatively low cost.

The optional display 109 may comprise LED's (light emitting diodes) or other ON/OFF indicators for simplicity - for example, green LED's to indicating normal levels of monitor signals, and red LED's to indicate faults. LED's can also indicate that a call out has been made to a field maintenance engineer, and that such a call has been acknowledged.

Thus, it will appreciated that there may be provided, at very modest cost, a telemetry system which, to great advantage, utilises existing facilities of mobile telephones, to provide field maintenance engineers with reports as to, for example, fault conditions arising, fault conditions being cleared, daily reports of site status, and response to ad hoc user dial-in interrogation. Some examples of applications include remote monitoring of customer processes by chemical sales representatives; remote monitoring of chemical feed equipment by service technicians; remote inventory management by suppliers; and remote monitoring of any unmanned equipment, process or installation. All of this can be achieved with a very simple installation at the site, and by utilisation of existing, readily available and economical telephone equipment.

The term "voice" as used in this specification includes both real and synthesised speech. A "text" signal means a signal that, when decoded at a receiving device, appears as text on the display of the device.

In this specification, the verb "comprise" has its normal dictionary meaning, to denote non-exclusive inclusion. That is, use of the word

"comprise" (or any of its derivatives) to include one feature or more, does not exclude the possibility of also including further features.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS

1. A telemetry system comprising:

   a. input means arranged to receive a monitor signal from a plant to be monitored;

   b. a controller arranged to receive said monitor signal from the input means and to generate a control signal in response to said monitor signal;

   c. a report generating means arranged to receive said control signal and to generate in response thereto a report signal in either voice or text form; and

   d. transmission means for transmitting said report signal as either a PSTN or mobile telephone signal in the case of a voice report signal, and as a mobile telephone signal in the case of a text report signal.

2. A telemetry system according to claim 1, further comprising receiver means for receiving an interrogation signal as either a PSTN or mobile telephone signal:

   and wherein:

   said controller is adapted to generate a response signal in response to said interrogation signal, which response signal depends upon a parameter of said input signal; and

   said report generating means is arranged to receive said response signal and to generate in response thereto a report signal as aforesaid, which report signal is then transmitted by said transmission means as aforesaid.

3. A telemetry system according to claim 1 or 2, wherein said interrogation signal is a text signal, a tone signal, or a voice signal.

4. A telemetry system according to claim 1, 2 or 3, wherein said controller is arranged to be programmed by an external device, and is provided with an input/output port for communication with said external device.

5. A telemetry system according to claim 4, wherein said controller is arranged to run normally without connection to said external device.

6. A telemetry system according to any of the preceding claims, in combination with a mobile telephone arranged to receive voice and/or text messages transmitted by said transmission means.

7. A telemetry system according to claims 2 and 6, wherein the receiver means is arranged to receive said interrogation signal as input at and transmitted by said mobile telephone.

8. A telemetry system according to any of the preceding claims, in combination with a PSTN telephone arranged to receive voice messages transmitted by said transmission means.

9. A telemetry system according to claims 2 and 8, wherein the receiver means is arranged to receive said interrogation signal as a voice or tone signal input at and transmitted by said PSTN telephone.

10. A telemetry system according to any of claims 6, 7 or 8, wherein only one or more mobile telephone and/or one or more PSTN telephone is provided to receive said report signal, without the provision of a PC or other computing device.

11. A telemetry system according to claims 2 and 10, wherein only one or more mobile telephone and/or one or more PSTN telephone is provided to transmit said interrogation signal, without the provision of a PC or other computing device.

12. A telemetry system according to any of the preceding claims, wherein said input means is arranged to receive a plurality of said monitor signals from a plant to be monitored; said controller is arranged to receive said monitor signals from said input means and to generate a plurality of control signals in response to said monitor signals; said report generating means is arranged to receive said control signals and to generate in response thereto a plurality of report signals in either voice or text form; and said transmission means is arranged to transmit said report signals as either PSTN or mobile telephone signals in the case of a voice report signal, and as mobile telephone signals in the case of a text report signal.

13. A telemetry system according to any of the preceding claims, wherein said monitor signal or one of said monitor signals represents a fault condition, and a corresponding said report signal represents the fault occurring or the fault being cleared.

14. A telemetry system according to claim 12 or to claims 12 and 13, wherein at least some of said monitor signals represent current parameters of the plant.

15. A telemetry system according to claim 14, wherein the controller is arranged to produce respective said control signals corresponding to said monitor signals which represent current parameters of the plant, and the transmission means is arranged to transmit respective report signals corresponding to those control signals, at predetermined times.

16. A telemetry system according to any of the preceding claims, wherein said input means, controller and report generating means, and at least part of said transmission means, are contained within a common housing.

17. A telemetry system according to claim 16, wherein said common housing is ruggedised to protect the components inside the housing from mechanical impact and/or corrosive environments.

18. A telemetry system substantially as hereinbefore described with reference to the accompanying drawing.

The Patent Office

INVESTOR IN PEOPLE

Application No: GB 9929190.8 **Examiner:** Richard Howe
Claims searched: 1-18 **Date of search:** 21 March 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): H4K (KOC) ; H4L (LDA)

Int Cl (Ed.7): H04M (11/00) ; H04Q (9/00) ; G08C (17/02)

Other: Online : wpi ; epodoc ; japio

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	DE 197 47 878 A1	(Vaillant) - see especially column 1 lines 39-41	1-7,10-17
X	WO 98/27764 A2	(AT&T) - see whole document	1-7,10-17
X	WO 92/06551 A1	(Autotrol) - see whole document	1-7,10-17
X	CN 1 109 234 A	(Shunmin) - see abstract	1-5, 8-17
X	JP 1 149 596 A	(NEC) - see abstract	1-5, 8-17
X	JP 63 031 353 A	(NEC) - see abstract	1-5, 8-17
X	JP11 164 037 A	(Hitachi) - see abstract	1-5, 8-17
X	JP 9 149 142 A	(Sanreiki) - see abstract	1-5, 8-17
X	JP 8 126 800 A	(Kokusai Electric) - see abstract	1-5, 8-17
X	US 4 942 616	(Linstroth) - see whole document	1-5,8-17

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.